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Effect of Growth Substances through Tree Injection on Fruit Quality and Shelf Life of Banana cv. Grand Naine

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ABSTRACT

The "Effect of growth substances through tree injection on fruit quality and shelf life of banana cv Grand Naine" experiment was conducted at the Instructional Farm, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during the 2018–19 year. The experiment was laid out in Completely Randomized Design with nine treatments and three repetitions. The treatments included control (T_1), GA_3 @ 10 ppm (T_2), GA_3 @ 20 ppm (T_3), GA_3 @ 30 ppm (T_4), BA @ 2.5 ppm (T_5), BA @ 5.0 ppm (T_6), NOVEL$^+$ @ 0.5 % (T_7), NOVEL$^+$ @ 1.0 % (T_8) and NOVEL$^+$ @ 1.5 % (T_9). Growth substances were applied through injection at the time of bell appearance. The results of the present investigation revealed that the maximum TSS (21.87 ˚Brix), reducing sugars (7.84 %) and total sugars (17.73 %) in banana cv 'Grand Naine' were recorded by injection of GA_3 @ 30 ppm (T_4). However, the highest shelf life (11.13 days) was observed in the injection of NOVEL$^+$ @ 1.5 % (T_9) followed by GA_3 @ 30 ppm (T_4).

Keywords Banana, Tree injection, Gibberellic acid, Benzyladenine, Novel plus organic liquid nutrients.

INTRODUCTION

Banana (*Musa paradisiaca* L.) is a large herbaceous perennial monocotyledonous and monocarpic crop which belongs to family Musaceae in the order Scitamineae. Its origin is in the tropical region of South-East Asia and it is known as "*Apple of Paradise*". Banana crop has nutritional, medicinal and industrial value and is interwoven with Indian heritage and culture. It is known as "Kalpatharu" (Plant of Virtues) because of its greater socio-economic significance and numerous uses. Banana is commercially fourth important global food commodity after paddy, wheat and milk in terms of gross value of production and of great socio-economic significance. It is also a dessert fruit for millions, apart from a staple food owing to its rich and easily digestible carbohydrates with a calorific value of 67-137/100 g fruit. It is a good source of Vitamin A (190 IU per 100 g of edible portion) and Vitamin C (100 mg/100 g) and a fair source of Vitamin B_1 and B_2 (Rajan *et al.*2017). Fruits are also rich sources of minerals like magnesium, phosphorus, potassium, sodium and a fair source of calcium and

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iron. It provides a healthy and salt free balanced diet than many other fruits. It provides therapeutic benefits for the treatment of numerous ailments and includes a wide range of vitamins. One hectare of banana yields 37.5 million calories of energy as compared to 2.5 million calories from wheat and multifarious uses. About 24 bananas each weighing around 100g would provide the energy requirement (2400 calories per day) of a man (Singh and Uma 2007). South Gujarat region is the pioneer banana producing state and Grand Naine is leading commercial cultivar in Gujarat and Maharashtra states.

Nowadays, the practices of application of plant growth regulators and organic amendments are taken to delay or advance maturity and also to increase the fruit quality directly or indirectly by altering the chain of physiological activities inside the cell. Gibberellins are phytohormones that have been linked to both cell division and cell elongation, two processes that lead to growth. After anthesis, it is the cell expansion and cell density, which contribute the most to fruit growth and as such, a positive correlation between growth of fruit tissues and gibberellin level is well established (Jackson and Coombe 1966 and Wiltbank and Krezdorn 1969).

BA (6-Benzyladenine) also called BAP (6-benzyl amino purine), is a synthetic cytokinin that stimulates cell division in plants. Among other actions, it spurs plant growth and improves fruit quality. The effects of synthetic cytokinins are consistent with the functions of endogenous compounds. Delay in senescence is caused by increased chloroplast differentiation and chlorophyll synthesis after application (Buban 2000).

Novel plus organic liquid nutrients (NOVEL$^+$) is a product of Navsari Agricultural University, Navsari patented in 2012. It is prepared from banana pseudostem sap. NOVEL$^+$ contains all the nutrients viz. N, P, K, Ca, Mg, S, B, S, Mn, Cu, Zn, Fe. Not only these, but it also contains plant growth hormones like gibberellic acid and cytokinins. NOVEL$^+$ also contains bacteria which can improve soil health and additional insecticidal properties due to the incorporation of different botanicals in formulation which collectively improve the production and quality of banana fruit. It can be used in different crops in different stages by various methods like fertigation, drenching, foliar spray, injection, cone feeding. (Kolambe *et al.*2013).

Application of growth substances through tree injection is a new technique in banana. It is applied to the banana plant at the time of bell emergence and eventually leads to improving the quality of banana fruit. The aim of this work was to evaluate the effect of growth substances through injection on fruit quality and shelf life of banana cv 'Grand Naine.'

MATERIALS AND METHODS

The present investigation was carried out at Instructional Farm, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during 2018-19. In order to prepare the experimental plot, severe ploughing, harrowing, and levelling were used. At the time of planting, well-decomposed, fine-textured farm yard manure was added at a rate of 10 kg per pit into the 30 cm 30 cm 30 cm pits, which were spaced 2.4 m 1.2 m apart. Grand Naine banana tissue culture plants with 5–6 leaves that are well-hardened and healthy were used for planting. 100 ml of the solution was injected at the base of the ¼th tip of the spathe at the time of bell emergence. Growth substances were injected into the bell, while it was still upright using an injection gun (Fig. 1). The experiment was laid out in Completely Randomized Design with three repetitions and nine treatments viz., control (T_1), GA_3 @ 10 ppm (T_2), GA_3 @ 20 ppm (T_3), GA_3 @ 30 ppm (T_4), BA @ 2.5 ppm (T_5), BA @ 5.0 ppm (T_6), NOVEL$^+$ @ 0.5 % (T_7), NOVEL$^+$ @ 1.0 % (T_8), NOVEL$^+$ @ 1.5 % (T_9). The observations were recorded for quality characters i.e. TSS (˚Brix), titrable acidity (%), reducing sugars (%), non-reducing sugars, total sugars (%), ascorbic acid content (mg/100 g pulp), physiological loss in weight (%) and shelf life (days). Total Soluble Solids of the fruit were recorded by using a hand refractometer having a range of 0-32 ˚Brix. Titrable acidity (%) was calculated by the method described by Ranganna (1986) adopted for estimation of titrable acidity. The formula used to calculate it is as follows.

$$\text{Titrable acidity \%} = \frac{\text{Titre} \times \text{Normality of Alkali} \times \text{Volume made up} \times \text{Equivalent weight of citric acid}}{\text{Volume of sample taken for} \times \text{Weight of sample taken for estimation} \times 1000} \times 100$$

Fig. 1. Injecting of different growth substances.

estimation

Reducing sugars (%) was assessed by the Lane and Eynon titration method described by Ranganna (1986) was adopted for estimation of reducing sugars. It was calculated according to following formula.

$$\text{Reducing sugars (\%)} = \frac{\text{Glucose Eq (0.05)} \times \text{Total volume made up}}{\text{Titre} \times \text{Weight of the pulp}} \times 100$$

Non-reducing sugars percentage was calculated by subtracting the reducing sugars (%) from the total sugars (%).

The total sugars (%) content was calculated according to the following formula

$$\text{Total sugars (\%)} = \frac{\text{Glucose Eq. of Fehling's solution (0.05)} \times \text{Total volume made up} \times \text{Volume made up after inversion}}{\text{Titre} \times \text{Weight of pulp taken} \times \text{Aliquot took for inversion}} \times 100$$

Ascorbic acid content was determined by the Dye method as detailed by Ranganna (1986).

$$\text{Ascorbic acid (mg 100g}^{-1}\text{ pulp)} = \frac{\text{Titre} \times \text{Dye Factor} \times \text{Volume made up}}{\text{Aliquot of extract} \times \text{Weight of sample}} \times 100$$

taken for estimation

$$\text{Dye Factor} = \frac{\text{taken for estimation} \times 0.5}{\text{Titre}}$$

Physiological loss in weight (%) was calculated according to the following formula.

$$\text{PLW (\%)} = \frac{\text{Initial weight of fruit - Final weight}}{\text{Initial weight}} \times 100$$

The shelf life of fruit was judged by keeping the fruits under ambient conditions. It was recorded as the days taken from harvesting to optimum eating stage.

The data recorded during the course of investigation were subjected to statistical analysis following standard procedure described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

For assessing the influence of different treatments on fruit quality parameters viz., TSS, titrable acidity, reducing sugars, non-reducing sugars, total sugars,

Table 1. Effect of growth substances through injection on quality parameters of banana cv Grand Naine.

Treatments	TSS (ºBrix)	Titrable acidity (%)	Reducing sugars (%)	Non-reducing sugars (%)	Total sugars (%)	Ascorbic acid content (mg/100 g pulp)	Physiological loss in weight (%)
T_1 - Control	19.07	0.173	6.60	8.42	15.02	4.67	17.13
T_2 - GA_3 @ 10 ppm	19.33	0.160	6.82	8.32	15.14	4.80	17.00
T_3 - GA_3 @ 20 ppm	19.99	0.160	7.09	8.40	15.49	5.33	16.63
T_4 - GA_3 @ 30 ppm	21.87	0.160	7.84	9.89	17.73	5.73	16.21
T_5 - BA @ 2.5 ppm	19.51	0.173	6.66	8.62	15.28	4.93	17.07
T_6 - BA @ 5.0 ppm	19.66	0.167	7.10	8.72	15.82	5.47	17.35
T_7 - NOVEL+ @ 0.5 %	19.86	0.173	7.11	9.21	16.32	5.33	17.48
T_8 - NOVEL+ @ 1.0 %	20.00	0.167	7.19	9.22	16.41	5.47	17.03
T_9 - NOVEL+ @ 1.5 %	21.71	0.167	7.59	9.64	17.24	5.47	16.57
SEm ±	0.45	0.005	0.20	0.38	0.28	0.26	0.53
CD @ 5 %	1.33	NS	0.60	NS	0.84	NS	NS
CV %	3.84	5.66	4.93	7.36	3.04	8.68	5.47

ascorbic acid content, physiological loss in weight and shelf life in banana fruit were determined. Among these parameters, all the parameters were significantly affected due to different treatments of the study except titrable acidity, non-reducing sugars, ascorbic acid content and physiological loss in weight of fruit.

In present investigation injection of GA_3 @ 30 ppm (T_4) gave the highest TSS, reducing sugars and total sugars in banana without any significant difference with NOVEL+ @ 1.5 % (T_9). However, the maximum shelf life of banana fruit was observed in injection of NOVEL+ @ 1.5 % (T_9).

The data presented in Table 1 revealed that TSS (˚Brix) content in banana fruit was significantly influenced by various treatments. Significantly, the highest TSS (21.87 ˚Brix) was observed in injection of GA_3 @ 30 ppm (T_4), which was at par with NOVEL+ @ 1.5 % (T_9) being 21.71 ºBrix. Whereas, the lowest TSS (19.07 ˚Brix) was recorded in control (T_1). It might be due to the quick metabolic transformation of starch into soluble sugars and rapid mobilization of photosynthetic metabolites and minerals from other parts of the plant to developing fruits (Jayalakshmi and Arumugam 2018). These results are in agreement with the findings of Ebeed *et al.* (2008) in banana; Patel *et al.* (2011) in banana; Biswan and Nair (2012) in banana; Lal and Das (2017) in guava and Maurya *et al.* (2018) in guava.

The perusal of the data showed that different treatments had a significant effect on reducing sugars (%) and total sugars (%) content in banana fruit (Table 1). Significantly, the highest reducing sugars (7.84 %) were observed in injection of GA_3 @ 30 ppm (T_4), which was at par with NOVEL+ @ 1.5 % (T_9) being 7.59 %. However, the lowest reducing sugars (6.60 %) were noticed in control (T_1). Significantly the maximum total sugars (17.73 %) were reported under injection of GA_3 @ 30 ppm (T_4), which was statistically at par with NOVEL+ @ 1.5 % (T_9) being 17.24 %. Whereas, minimum total sugars (15.02 %) were noted in control (T_1). This progressive increase could be related to increase in Total Soluble Solids content of fruits. It might be due to the increased the activity of hydrolytic enzymes which converted complex polysaccharides into simple sugars. Growth regulators also increase translocation of photosynthetic metabolites from other parts of the plant towards to developing fruits (Lal and Das 2017). Jayalakshmi and Arumugam (2018) opined that the increased sugar content due to GA_3 application might be due to its active role in diverting the translocation of soluble solids to fruits. This is in line with earlier findings by Biswan and Nair (2012) in banana; Digal (2016) in banana and Maurya *et al.* (2018) in guava.

The data presented indicated that shelf life of banana fruit was significantly influenced by various treatments (Fig. 2). Significantly, the maximum shelf life (11.13 days) was observed in injection of

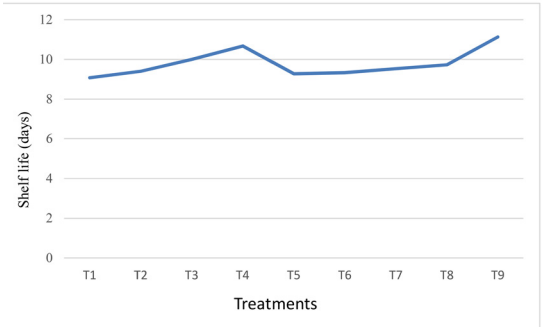

Fig. 2. Effect of growth substances through tree injection on shelf life of banana cv 'Grand Naine'.

NOVEL+ @ 1.5 % (T_9), which was statistically at par with GA_3 @ 30 ppm (T_4) being 10.67 days. While, minimum shelf life (9.07 days) was noted in control (T_1). Novel plus organic liquid nutrients contain growth promoting substances like GA_3 and cytokinin. Application of GA_3 may have decreased tissue permeability and thereby reduced the rate of water loss. Further, cytokinin may have delayed ethylene production and reduced respiration which could have contributed to increased shelf life of fruits (Zomo *et al.* 2014 and Hemalatha *et al.* 2015). Similar results were recorded by Gurjar (2017) in banana and Parmar *et al.* (2017) in mango.

From the result of the present experiment, it can be concluded that injection of GA_3 @ 30 ppm at the time of bell emergence improved the quality of banana fruits like TSS, reducing sugars and total sugars. Whereas, injection of Novel plus organic liquid nutrients @ 1.5 % was found better for the shelf life of banana fruits. It also emerged as the second best treatment for quality of banana fruit.

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